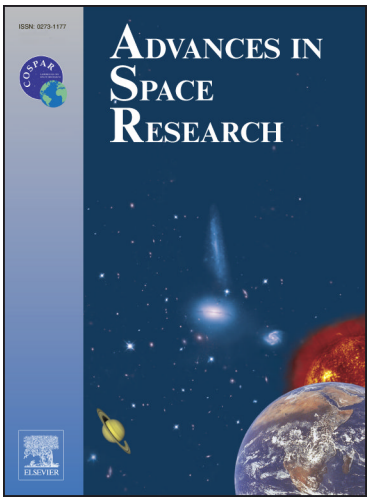


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# USE OF GLOBAL IONOSPHERIC MAPS FOR HF DOPPLER MEASUREMENTS INTERPRETATION

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**Abstract.** The HF Doppler technique, a method of measurement of Doppler frequency shift of ionospheric signal, is one of the well-known and widely used techniques of ionosphere research. It allows investigation of various disturbances in the ionosphere. There are different sources of disturbances in the ionosphere such as geomagnetic storms, solar flashes, meteorological effects and atmospheric waves. The HF Doppler technique allows us to find out the influence of earthquakes, explosions and other processes on the ionosphere, which occurs near the Earth. HF Doppler technique has high sensitivity to small frequency variations and high time resolution but interpretation of results is difficult. In this paper, we attempt to use GPS data for Doppler measurements interpretation. Modeling of Doppler frequency shift variations with use of TEC allows separation of ionosphere disturbances of medium scale.

## 1. Introduction

Study of processes in the upper atmosphere and ionosphere is one of the most important and interesting problem of geophysics. Atmospheric gravity waves propagating into the thermosphere play an important role in coupling between different regions. Signatures of atmospheric waves in the ionosphere are called travelling ionospheric disturbances (TID). They can be detected by a number of different instruments and methods including ionosondes [Negrea et al., 2016, Reinisch et al., 2009; Akchurin et al., 2011], multiple-receiver GPS measurements [Azeem et al.,2017, Chen et al.,2016, Otsuka et al.,2013,], HF Doppler technique [Crowley and Rodrigues, 2012, Lastovicka and Chum 2017,Petrova et al., 2009] and others.

HF Doppler technique based on frequency shift measurements is the method of ionosphere process investigation. The advantages of the HF Doppler technique are high sensitivity to small frequency variations and high time resolution. It allows investigation of various disturbances in the ionosphere. Moreover, the Doppler system is a relatively cheap instrument characterized by low power consumption. Therefore, it can be used for multiple-day ionosphere monitoring.

Doppler measurements allow analyzing temporal properties of ionospheric disturbances, which wave periods are in the range from seconds to days The spectral analysis gives information about typical periods of wave processes and allows us to detect irregularities of different scales in the ionosphere. The results of spectral analysis for Doppler shift variations with periods in range from one minute to 60 days have been presented in [Petrova et al., 2009].

Crowley and Rodrigues [2012] presented observation results of medium-scale travelling ionospheric disturbances (TID) obtained using a new HF Doppler sounder (TIDDBIT - TID Detector Built in Texas) designed to provide continuous monitoring of TID activity and estimation of TID propagation parameters. The TIDDBIT system data confirm the relationship between atmospheric gravity waves and TID.